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Claims

[c1] 1. A method for routing a transmission line through a wall of a tool joint having a primary and secondary shoulder, a central bore, and a longitudinal axis, the method comprising:
forming a first channel at a nominal angle, that is positive with respect to the longitudinal axis, through the wall of the tool joint from the secondary shoulder to a point proximate an inside wall of the central bore; and forming a second channel, from the inside wall within the central bore, the second channel effective to merge with the first channel, thereby forming a continuous channel from the secondary shoulder to the central bore.

[c2] 2. The method of claim 1, wherein the first channel is formed by gun-drilling.

[c3] 3. The method of claim 1, further comprising tilting the tool joint before forming the first channel to produce the angle.

[c4] 4. The method of claim 3, further comprising adjusting the tilt before forming the first channel to provide a desired positive angle.

[c5] 5. The method of claim 1, wherein the nominal angle is greater than or equal to about .25 degrees.

[c6] 6. The method of claim 1, wherein the first channel does not break into the central bore.

[c7] 7. The method of claim 1, wherein the first channel breaks into the central bore at a non-perpendicular angle.

[c8] 8. The method of claim 7, wherein a backing member is inserted into the central bore to facilitate a break through of the first channel into the central bore.

[c9] 9. The method of claim 1, wherein the second channel is formed with a milling tool inserted into the central bore.

[c10] 10. The method of claim 1, wherein the nominal angle is between about .25 degrees and about 15 degrees.

[c11] 11. An apparatus comprising:
a tool joint for use with a downhole tool, the tool joint comprising a primary and secondary shoulder, a central bore, and a longitudinal axis;
a gun-drilled channel formed in the tool joint from the secondary shoulder to a point proximate the central bore; and
an open channel milled from the central bore to the gun-

drilled channel, such that the gun-drilled channel and the open channel merge to form a continuous channel.

[c12] 12. The apparatus of claim 11, wherein the gun-drilled channel is drilled at a nominal positive angle with respect to the longitudinal axis.

[c13] 13. The apparatus of claim 12, wherein the nominal positive angle is greater than about .25 degrees and less than or equal to about 15 degrees.

[c14] 14. The apparatus of claim 11, wherein the gun-drilled channel does not break into the central bore.

[c15] 15. The apparatus of claim 11, wherein the gun-drilled channel breaks into the central bore at a non-perpendicular angle.

[c16] 16. The apparatus of claim 11, wherein the gun-drilled channel breaks into the central bore substantially perpendicularly.

[c17] 17. The apparatus of claim 11, wherein the open channel is milled with a milling tool inserted into the central bore.

[c18] 18. A method for routing a transmission line through a tool joint of a downhole tool, wherein the tool joint includes primary and secondary shoulders, a tool wall, a

central bore, and a longitudinal axis, the method comprising:

increasing the inside diameter of a portion of the central bore to provide a first portion having a standard diameter, and a second portion having an enlarged diameter; and

drilling a channel through the tool wall from the secondary shoulder to an exit point within the second portion.

[c19] 19. The method of claim 18, wherein drilling further comprises gun-drilling.

[c20] 20. The method of claim 19, wherein gun-drilling does not break into the central bore.

[c21] 21. The method of claim 20, wherein drilling further comprises milling back from the central bore to the gun-drilled channel.

[c22] 22. The method of claim 21, wherein milling back opens up the channel to the central bore.

[c23] 23. The method of claim 18, wherein the channel breaks into the central bore at a non-perpendicular angle.

[c24] 24. The method of claim 23, wherein a backing member is inserted into the central bore to facilitate drilling into

the central bore at a non-perpendicular angle.

[c25] 25. The method of claim 18, wherein the channel breaks into the central bore at a substantially perpendicular angle.

[c26] 26. A method for routing a transmission line through a downhole tool having primary and secondary shoulders, a central bore, and a longitudinal axis, the method comprising:
drilling a straight channel through the downhole tool at a positive nominal angle with respect to the longitudinal axis from the secondary shoulder to a point proximate the inside wall of the central bore; and
milling back, from within the central bore, a second channel effective to merge with the straight channel, to form a continuous channel from the secondary shoulder to the central bore.

[c27] 27. The method of claim 26, wherein the straight channel is formed by gun-drilling.

[c28] 28. The method of claim 26, further comprising tilting the tool joint before forming the straight channel to produce the angle.

[c29] 29. The method of claim 28, further comprising adjusting the tilt before forming the straight channel to pro-

vide a desired positive angle.

[c30] 30. The method of claim 26, wherein the nominal angle is greater than or equal to about .25 degrees.

[c31] 31. The method of claim 26, wherein the straight channel does not break into the central bore.

[c32] 32. The method of claim 26, wherein the straight channel breaks into the central bore at a non-perpendicular angle.

[c33] 33. The method of claim 32, wherein a backing member is inserted into the central bore to facilitate drilling the straight channel as it breaks out into the central bore.

[c34] 34. The method of claim 26, wherein the second channel is formed with a milling tool inserted into the central bore.

[c35] 35. The method of claim 26, wherein the nominal angle is between about .25 degrees and about 15 degrees.